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Claims

What is claimed is

- 5 1. An arrangement for displaying images of a scene or object,
- comprising an image display device (1) consisting of a multitude of light-transmitting image rendering elements, which are arranged in a raster of rows and/or columns and on which bits of image information from several perspective views of the scene or object can be displayed,
 - 10 - and comprising a plane wavelength filter array (3), which is arranged (in the viewing direction of an observer 7) behind the image display device (1), and which consists of a multitude of filter elements arranged in rows and/or columns, part of which are transparent to light of specified wavelength ranges, whereas the remaining part are opaque,
 - 15 - and comprising controllable means of illumination providing at least two modes of operation, in which
 - in a first mode of operation, light from a first light source (2) arranged behind the wavelength filter array (3) reaches the observer (7) by passing through at least part of the light-transmitting filter elements and subsequently through a correlated part of the image rendering elements of the image display device, so that the scene or object is seen by the observer (7) in three dimensions, and in which
 - 20 - in a second mode of operation, light from a second light source (4) having at least one emission plane that is arranged between wavelength filter array (3) and image display device (1) and that is essentially parallel to the wavelength filter array (3), leaves the said emission plane or emission planes and reaches the observer (7) by passing through the image rendering elements of the image display device (1) but not through the filter elements of the wavelength filter array (3), so that the scene or object is seen by the observer (7) at least partially in two dimensions, and in which
 - 25 - means are provided for uniform illumination in the second mode of operation.
- 30 2. An arrangement as claimed in Claim 1, in which
- the second light source (4) is a planar light source configured as an optical waveguide slab (light guide) (19), and in which
 - the light guide (19) has two mutually opposite large surfaces (12) and peripheral narrow surfaces, and the large surface (12) facing the image display device (1) or away from it corresponds to the emission plane, or both large surfaces (12) correspond to the emission planes, and in which
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- the light guide (19) receives light from one or several laterally arranged light sources (5), and in which
 - the light is coupled into the light guide (19) via one or several of the narrow surfaces, partially reflected back and forth by total reflection off the large surfaces (12),
5 and partially coupled out at the large surface (12) corresponding to the emission plane or the large surfaces (12) corresponding to the emission planes.
3. An arrangement as claimed in Claim 1 or 2, in which, in the second mode of operation, the first light source (2) is switched on in addition to the second light source
10 (4), only the large surface (12) facing away from the image display device is intended as an emission plane, and, to provide uniform illumination, only those areas of the emission plane are intended for light emission that, in case of projection onto the wavelength filter array (3) along a direction normal to the plane, are essentially congruent with the areas occupied by opaque filter elements.
- 15 4. An arrangement as claimed in Claim 3, in which the wavelength filter array (3) is provided on the large surface (12) corresponding to the emission plane.
5. An arrangement as claimed in Claim 3 or 4, in which the large surface (12) corresponding to the emission plane is, in the areas intended for emission, coated with a
20 structure that interferes with total reflection, the structure preferably consisting of a coat of particles.
6. An arrangement as claimed in Claim 5, in which the interfering capability of the particles across the emission plane is inhomogeneous, ranging between two limit values that vary with the density of particles in the coating.
- 25 7. An arrangement as claimed in Claim 6, in which the interfering capability of the particles in each single coated area is essentially constant.
- 30 8. An arrangement as claimed in Claim 6 or 7, in which two parallel, opposite narrow surfaces are intended for inward light coupling, and in which the interfering capability of the coated areas, arranged in stripe-shaped segments aligned in parallel with the narrow surfaces, progressively increases with increasing distances x_1 , x_2 up to a
35 common maximum.

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9. An arrangement as claimed in Claim 5, in which the interfering capability of the particles is essentially homogeneous, both within each of the partial areas and across the emission plane as a whole.
- 5 10. An arrangement as claimed in Claim 9, in which two mutually opposite, vertical narrow surfaces are intended for inward light coupling, and in which, in selected, non-overlapping areas of the wavelength filter array (3) comprising one or several rows or/and columns each and, together, completely covering the wavelength filter array (3), the ratio between the surface areas covered by filter elements that transmit light
10 of specified wavelength ranges and the surface areas covered by opaque filter elements is defined depending on the maximally achievable luminance in those partial areas of the emission plane of the planar light source that, in case of projection along a direction normal to the plane, each correspond to one of the selected areas thus selected of the wavelength filter array.
- 15 11. An arrangement as claimed in any of the Claims 5 through 10, in which an essentially light-absorbing layer is provided on top of the coat that interferes with total reflection.
- 20 12. An arrangement as claimed in any of the previous Claims, in which the means of illumination is provided with a device to control the first light source (2) so as to create a luminance gradient over the plane of the wavelength filter array (3).
- 25 13. An arrangement as claimed in any of the previous Claims, in which in the means of illumination comprises a first light source (2) that is a discharge lamp provided with a plane sealing glass on the side facing the wavelength filter array (3) and parallel to it, and with a phosphor coating provided on the inside of the sealing glass.
- 30 14. An arrangement as claimed in Claim 13, in which the phosphor coating is only applied on areas that, in case of projection onto the wavelength filter array (3) along a direction normal to the plane, are essentially congruent with the areas covered by filter elements that transmit light of specified wavelength ranges.
- 35 15. An arrangement as claimed in Claim 13 or 14, in which the wavelength filter array (3) is provided on the outside of the sealing glass.

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16. An arrangement as claimed in any of the previous Claims, in which, in the second mode of operation, part of the light of the first light source (2) is coupled out and then re-coupled into the second light source (4) by means of optical elements, this part of the light being defined by the ratio between the wavelength filter array's surface areas covered by filter elements that transmit light of specified wavelength ranges and the surface areas covered by opaque filter elements.
17. An arrangement as claimed in Claim 16, in which light guides and/or reflecting elements are provided for outcoupling and inward coupling.
18. An arrangement as claimed in any of the previous Claims, in which an optically effective material, preferably a filter plate or a thin foil having a microstructure of prismatic effect, is arranged between the first and second light sources (2, 4), so that light of the first light source (2) having angles of incidence greater than the critical angle of the second light source (4) is essentially prevented from entering the second light source (4).
19. An arrangement as claimed in Claim 1, in which the second light source (4) consists of a great number of separately controllable, individual light sources that radiate light towards the image display device and that, simultaneously, are configured as opaque filter elements in the wavelength filter array (3).
20. An arrangement as claimed in Claim 19, in which the light sources are light-emitting, essentially plane polymer layers.
21. An arrangement for displaying images of a scene or object,
- comprising an image display device (1) consisting of a multitude of translucent image rendering elements, on which bits of image information from several perspective views of the scene or object can be displayed,
 - and comprising an array, which is arranged (in the viewing direction of an observer) behind the image display device (1), and which contains a multitude of individually controllable light sources arranged in rows and/or columns and intended to emit light of specified wavelength ranges, in which
 - in a first mode of operation, light is emitted by those light sources only whose light reaches the observer through those of the image rendering elements of the image display device (1) that are each assigned to the respective light source, so that a three-dimensional image is displayed, and in which

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- in a second mode of operation, light is emitted additionally by at least another part of the light sources whose light reaches the observer through image rendering elements of the image display device (1) without any special assignment, so that the image displayed is, at least in part, two-dimensional.

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22. An arrangement as claimed in Claim 21, in which the light sources are essentially plane, light-emitting polymer layers.

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23. An arrangement as claimed in Claim 21, in which a liquid crystal display is provided as a light source.

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24. An arrangement as claimed in Claim 2, in which the means of uniform illumination in the second mode of operation is a light outcoupling structure (13) that can be switched on and off and is provided on at least one of the large surfaces (12).

25. An arrangement as claimed in Claim 24, in which the light outcoupling structure (13) that can be switched on and off is a switchable scattering layer.

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26. An arrangement as claimed in Claim 25, in which the switchable scattering layer is switched to be transparent in the first mode of operation and scattering in the second mode of operation.

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27. An arrangement as claimed in Claim 26, in which, in the second mode of operation, only partial surfaces (20) of the switchable scattering layer are switched to be scattering.

28. An arrangement as claimed in Claim 27, in which the partial areas (20) are stripe-shaped.

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29. An arrangement as claimed in Claim 28, in which the stripe-shaped partial areas (20) differ in width.

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30. An arrangement as claimed in Claim 29, in which every two adjacent partial areas (20) that are switched to be scattering are separated by permanently transparent stripe-shaped partial areas (21), so that the degree of light outcoupling from the light guide (19) per unit area differs from place to place on the light guide (19).

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- 5 31. An arrangement as claimed in any of the Claims 24 through 30, in which the switchable scattering layer in the second mode of operation is switched to have differing degrees of scattering from place to place, so that the degree of light outcoupling from the light guide (19) differs from place to place on the light guide (19).
32. An arrangement as claimed in Claim 31, in which pairs of different control signals are applied to different places on the switchable scattering layer to produce different degrees of scattering in these places.
- 10 33. An arrangement as claimed in any of the Claims 24 through 32, in which the opaque filter elements on the side of the wavelength filter array (3) that faces the observer are diffusely scattering.
- 15 34. An arrangement as claimed in any of the Claims 24 through 33, in which the large faces (12) of the light guide (19) have plane and/or textured surfaces.
- 20 35. An arrangement as claimed in any of the Claims 24 through 34, in which the switchable scattering layer is a liquid crystal layer – for example, one having a cholesteric-nematic transition) – that is transparent to light if a suitable voltage is applied and that scatters light if such voltage is missing.
- 25 36. An arrangement as claimed in Claim 2, in which the means for uniform illumination in the second mode of operation is a switchable scattering disk (22) arranged between the light guide (19) and the image display device (1), this scattering disk being switched to be transparent in the first mode of operation and, at least over part of its surface, scattering in the second mode of operation, so that the brightness contrast of the light passing the switchable scattering disk (22) in the second mode of operation is reduced.
- 30 37. An arrangement as claimed in any of the Claims 24 through 36, in which, in the second mode of operation, the first light source (2) is switched on in addition to the second light source (4).
- 35 38. An arrangement for displaying images of a scene or object,
- comprising an image display device (1) consisting of a multitude of light-transmitting image rendering elements, which are arranged in a raster of rows

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- and/or columns and on which bits of image information from several perspective views of the scene or object can be displayed,
- and comprising at least two plane wavelength filter arrays (23, 24) which are arranged (as seen in the viewing direction of an observer 7) behind the image display device (1), and each of which consists of a multitude of filter elements arranged in rows and/or columns, part of which are transparent to light of specified wavelength ranges, whereas the remaining part are opaque to light, with one of the wavelength filter arrays (23 or 24) being shiftable relative to the other (24 or 23, respectively), and with both arrays preferably being in close contact with each other,
 - 10 - and comprising a preferably planar light source (2) arranged (in viewing direction) behind the wavelength filter arrays (23, 24),
 - and comprising a switchable scattering disk (22) that is arranged between the image display device (1) and the wavelength filter arrays (23, 24) at a sufficient distance from the latter, and that is switched to be transparent in the first mode of operation and, at least over part of its surface, scattering in the second mode of operation,
 - 15 - in which, in a first mode of operation, the wavelength filter arrays (23, 24) occupy such positions relative to each other that the light emitted by the light source (2) arranged behind the wavelength filter arrays (23, 24) reaches the observer (7) by passing through at least part of the light-transmitting filter elements of both wavelength filter arrays (23, 24) and subsequently through a correlated part of the image rendering elements of the image display device (1), so that the scene or object is seen by the observer (7) in three dimensions, and in which
 - 20 - in a second mode of operation, the switchable scattering disk (22) is switched to be scattering at least over part of its area, and the wavelength filter arrays (23, 24) have such positions relative to each other that, compared to the first mode of operation, more light reaches the observer (7) by passing through the light-transmitting filter elements of both wavelength filter arrays (23, 24) and subsequently through the scattering disk (22) that is switched to be scattering in the second mode of operation and through the image rendering elements of the image display device (1), so that the scene or object is seen by the observer (7) in two dimensions.
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39. An arrangement as claimed in Claim 38, in which a number W of more than two wavelength filter arrays are provided, a number of at least W-1 of them being shiftable.

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40. An arrangement as claimed in any of the Claims 38 or 39, in which the shifting of each shiftable wavelength filter array (23, 24) takes place in the row direction of the raster of image rendering elements of the image display device.
- 5 41. An arrangement as claimed in Claim 40, in which the length of shifting of each shiftable wavelength filter array (23, 24) is smaller than the horizontal period of the light-transmitting filter elements provided on the respective wavelength filter array (23, 24), if such a period is provided.
- 10 42. An arrangement as claimed in any of the Claims 38 through 41, in which each shiftable wavelength filter array (23, 24) is provided with an electromechanical control element, e.g., a piezoelectric positioner, which effects the shifting.
- 15 43. An arrangement as claimed in Claim 2, in which the means for uniform illumination in the second mode of operation is an optically scattering foil (44) arranged between the wavelength filter array (3) and the light guide (19).
- 20 44. An arrangement as claimed in Claim 43, in which switching into the first mode of operation is effected by removing the foil (44) between the wavelength filter array (3) and the light guide (19), preferably by means of a winding and unwinding mechanism (45).
- 25 45. An arrangement as claimed in Claim 43, in which the foil is an electrophoretic component (43), which is optically scattering in the second mode of operation and transparent to light in the first mode of operation, the switching between the second and first modes being effected by influencing the electrophoretic properties.
- 30 46. An arrangement as claimed in any of the Claims 24 through 37 or 43 through 45, in which the wavelength filter array (3) is an electrophoretic component provided with a control device, in which the opaque filter elements are switched to absorb light in the first mode of operation and to reflect light in the second mode of operation (as seen from the direction of the observer 7).
- 35 47. An arrangement for displaying images of a scene or object,
- comprising an image display device (1) consisting of a multitude of light-transmitting image rendering elements, which are arranged in a raster of rows

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- and/or columns and on which bits of image information from several perspective views of the scene or object can be displayed,
- and comprising a plane, controllable wavelength filter array (3), which is arranged (in the viewing direction of an observer 7) behind the image display device (1), and
 - 5 which consists of a multitude of filter elements arranged in rows and/or columns, part of which are transparent to light of specified wavelength ranges,
 - and comprising a preferably planar light source (2) arranged (in viewing direction) behind the wavelength filter array (3),
 - in which, in a first mode of operation, the remaining part of the filter elements are
 - 10 controlled to be opaque to light, light emitted by the light source reaches the observer (7) by passing through at least part of the light-transmitting filter elements and subsequently through a correlated part of the image rendering elements of the image display device (1), so that the scene or object is seen by the observer (7) in three dimensions, and in which
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 - the wavelength filter array (3) is an electrophoretic component (40) and, in a second mode of operation, the remaining part of the filter elements are controlled to be transparent to light, so that the scene or object is seen by the observer (7) in two dimensions.
- 20 48. An arrangement as claimed in any of the previous Claims, in which, in the first mode of operation providing at least partially three-dimensional display, either eye of the observer predominantly, but not exclusively sees a particular selection of the displayed bits of information from several perspective views of the scene or object, so that the observer has a spatial impression.

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Summary of the Invention

- 5 This invention relates to an arrangement for two- or three-dimensional display comprising an image display device (1) consisting of a multitude of light-transmitting image rendering elements, on which bits of image information from several perspective views can be displayed, and further comprising a wavelength filter array (3) and controllable means of illumination providing at least two modes of operation; in a first mode of operation, light
10 emitted by a first light source (2) arranged behind the wavelength filter array (3) reaches the observer (7) by passing through at least part of the light-transmitting filter elements and subsequently through a correlated part of the image rendering elements of the image display device (1), so that the scene or object is seen by the observer in three dimensions.
- 15 In a second mode of operation provided by such an arrangement, light emitted by a second light source (4) reaches the observer (7) by passing through the image rendering elements of the image display device (1) but not through the filter elements of the wavelength filter array (3), so that the scene or object is seen by the observer (7) at least partially in two dimensions, with uniform illumination in the second mode of operation being
20 provided by suitable means.

[END OF TRANSLATION]

- 25 Hereby I certify that the foregoing text is a faithful and complete translation of an original German patent application, which was put before me today and a copy of which is affixed to the translation.

Jena, *June 9th, 2004*

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- 35 Appointed by the President of the Gera Regional Court
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